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ABSTRACTS FROM ASTRONOMICAL PUBLICATIONS.

In accordance with a recent arrangement the members of the scientific staff of the Lick Observatory hold meetings once per week, as an observatory duty, to report upon and discuss the more important articles appearing in the journals of astronomy, the important new books on astronomical subjects, or subjects of current and special interest in the observatory's work. It has been suggested that abstracts of the reports would be of interest to the readers of these *Publications*, and the Publication Committee has acted favorably upon the suggestion.

It is intended to preserve the qualities of abstracts as far as possible, and to restrict published criticisms, favorable or unfavorable, to a minimum.

A NEW METHOD OF MEASURING SMALL DISPLACEMENTS OF SPECTRUM LINES.

Bulletin No. 32 of the Kodaikanal Observatory contains an important article by the Director, JOHN EVERSHED, describing a new method of measuring spectrograms.

The essence of the method consists in making a positive copy of the negative plate to be measured, in placing this positive copy, reversed end for end, almost in contact with the ordinary negative, and in moving the positive with reference to the negative so that the positive images of the lines coincide successively with the negative images of the corresponding lines. The positive measuring plate is adjusted in a special instrument so that there is a 0.05^{mm} separation of the two plates. The accuracy of the adjustment for coincidence of the two images of the lines depends upon the sensitiveness of the eye in estimating the change for the bright and dark contiguous images of a line, to the perfectly uniform density which results when the positive image exactly coincides with the negative. Mr. EVERSHED finds that the delicacy of this adjustment is greater than might have been anticipated, and is independent of the width of the lines. The principal advantage claimed for this method is that the accidental errors of measurement are reduced by reason of the double intervals measured. It is, in fact, almost equivalent to doubling the linear displacement of a plate without altering the width or definition of the lines. The method appears to be entirely free from large systematic errors which exist for most observers when they measure the displacements of the lines in an absorption spectrum with reference to the bright lines in a comparison spectrum.

The method cannot be used if there is asymmetry of the spectrum lines, for the reversal of the positive, right and left, brings the denser sides of the images together, and it is not possible to secure uniformity of illumination by any shifting of the positive plate. In such cases Mr. EVERSHED makes the positive copy by exposing *thru the glass* of the positive, and, in measuring, the positive is placed upon the ordinary negative in unreversed position. The dispersion effect is not doubled under these circumstances.

Various other photographic devices have been tried and found satisfactory. For example, two exposures of the original negative are made on an enlarged scale. One of these exposures is developed as an ordinary *positive,* and the other is treated chemically in the developing stage so as to appear as a *negative.* It has been found that the two *copies* may be measured with reference to each other, with extremely accurate results.

It is necessary that the slit of the spectrograph be adjusted to perfect perpendicularity to the length of the spectrum, which is easily done, and that the exposure of the original negative be timed to give correct intensity.

A number of possible objections to the method are mentioned by Mr. EVERSHED and shown to be insignificant, or at least no more serious than objections attaching to micrometric-wire methods of measurement.

Numerical examples are quoted. A spectrogram made for determining the rotation of the Sun was measured by the ordinary method and by the positive-on-negative method. The probable error of the mean result from the ordinary method was $\pm 0.012^{\text{km}}$ and from the positive-on-negative method $\pm 0.006^{\text{km}}$. For another spectrogram the probable errors were, old method, $\pm 0.016^{\text{km}}$, and new method, $\pm 0.006^{\text{km}}$. Fourteen plates for solar rotation had been measured to date, and in all of these the residuals are smaller by the new method, the average probable error being $\pm 0.015^{\text{km}}$ by the old method and $\pm 0.009^{\text{km}}$ by the new.

The settings upon well-defined lines in a comparison spectrum, such as that of iron, can also be made considerably more accurately by the new method than by the old.

The principles involved in EVERSHED's method resemble those of the HARTMANN spectro-comparator, but are capable of a much greater variety of applications. W. W. CAMPBELL.

ON AN AURORAL EXPEDITION TO BOSSEKOP IN THE SPRING OF 1913, BY CARL STÖRMER.[1]

This is a brief account of Professor STÖRMER's second expedition to Bossekop for the purpose of studying the aurora. The first one was undertaken in 1910, and the experience acquired on that occasion was very useful in planning the second one. The purposes of the expedition as set forth by the author were "to obtain more accurate, more numerous auroral photographs for the determination of the form of the aurora, and its height and situation in space, and, further, to experiment with objective-prism photographing and the taking of cinematograph films."

For the purpose of obtaining parallaxes simultaneous observations were made from two places about 27½ kilometers apart. The two stations were almost due north and south of each other. The observers had the use of the state telephone line between the stations, and in order to expedite intercommunication between them the switches and accessories were mounted on the observers themselves in such a manner as not to interfere with the free use of the arms. In this way it was found possible to make numerous simultaneous observations from the two stations, and, in all, data for 4,000 photographic determinations of parallax were secured.

Spectrum investigations seem to have been confined to the securing of photographs with the objective-prism. It is to be regretted that observations with a slit spectroscope were not undertaken so that accurate determinations of wave-length could be made.

The great number of photographs secured and the excellent quality of those reproduced to illustrate the article, attest the great value of the work of the expedition, the results of which will be worked up in detail for a later paper.

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[1] *Astrophysical Journal*, **38**, 311, 1913.

W. H. Wright.

Non-Selective Transmissibility of Radiation Through Dry and Moist Air, by F. E. Fowle.[1]

The data for this investigation were secured in the course of the measurement of the solar constant of radiation by the observers of the Smithsonian Astrophysical Observatory. Observation of the heat radiated by the Sun involves the determination, on each occasion, of the transparency of the atmosphere for rays of many different wave-lengths. On different days the amount of water-vapor varies, so that it is possible to set up an equation to allow for the effect of water-vapor on the transparency of the air, and to calculate the transparency of the dry air. The observations were made at Mt. Wilson and the values of the transparency discussed refer to the vertical column of air above that place.

The nature of the process of atmospheric absorption is one of great importance from many points of view. For instance, the validity of the method by which the effect of this absorption is allowed for in the investigation of the solar constant rests on the assumption that the absorption is "general," rather than "selective." Special interest, therefore, attaches to Mr. Fowle's comparison of his observed values with those computed by the aid of the formulæ due to Rayleigh, Schuster, and L. V. King on the supposition that the dimming of rays, on passing thru the atmosphere, is produced by the molecular scattering of the air. The agreement between observation and theory is most striking, as will be seen from the following table:—

Wage-lengths (Ångstroms)—	3700	4000	4300	4600	5000	6000	7500	10,000	15,000
Transmission of column of dry air vertically above Mt. Wilson—									
Observed	0.683	.757	.808	.851	.885[1]	.916[1]	.977	.987	.990
Computed	0.680	.755	.808	.850	.890[1]	.946[1]	.977	.987	.986

The results marked ([1]) are in regions of known selective absorption and the discrepancies are of the right sign to be accounted for by this fact. In all the other cases the agreement between theory and observation is remarkable and leaves little doubt that the absorption of light above Mt. Wilson on a perfectly dry day is due, except in the limited regions just referred to, to molecular scattering of light. The observations covered the spectrum from 3400 A to 17000 A.

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[1] *Astrophysical Journal,* **38**, 392, 1913.

Assuming now that the theory of scattering is correct, the author has reversed the process and determined the number of molecules in a cubic centimeter under standard conditions of temperature and pressure. The result, 2.56×10^{19} is in close agreement with the best determination by other methods, 2.71×10^{19} (MILLIKAN).

The effect of light scattering by molecules of water-vapor in the atmosphere is then taken up and is found to be much in excess of theory, the computed values being only one sixty-fourth of the observed ones. Several hypotheses are tentatively advanced to account for this great discordance. For details of these the original papers should be consulted.

In affording a pretty conclusive proof that the atmospheric absorption above Mt. Wilson is due practically entirely to molecular scattering of light, Mr. FOWLE has also shown that the sky at that place is practically free from dust or other foreign material. Astronomers working under such favorable conditions are certainly to be congratulated.

W. H. WRIGHT.

PRELIMINARY STATISTICS OF NEBULÆ AND CLUSTERS.

The Observatory of Lund has taken up the work of statistical investigation of nebulæ and clusters—that is, statistics of their brightness, size, form, and distribution over the celestial sphere. A card catalog has been formed containing all the information obtainable concerning these objects. Most of this information has been taken from DREYER'S three catalogs, which are, the New General Catalog of 7,840 Nebulæ and Clusters, 1890; the Index of 1,529 Nebulæ, 1895; the Second Index of 3,857 Nebulæ, 1908. These catalogs are found in the *Memoirs of the Royal Astronomical Society,* Volumes 49, 51, 59. The three catalogs contain a total of 13,226 objects which are distinguished by five classes: clusters, globular clusters, planetary nebulæ, annular nebulæ, nebulæ.

During the further collection and study of material, the director, C. V. L. CHARLIER, has considered it advantageous to publish the immediate statistical results obtained from the three catalogs, but without discussion. These preliminary results are presented in fifty-two tables and eleven charts in pamphlet No. 15 of the Swedish Academy of Stockholm. Certain facts are self-evident, but other conclusions must be drawn with great caution. The main interest of these preliminary results lies in the distribution of the objects with respect to the Milky Way. The first table and charts give the distribution of the objects with respect to forty-eight squares of the celestial sphere. The table shows that there are 657 clusters, 112 globular clusters, 133 planetary nebulæ, 13 annular nebulæ, 12,308 nebulæ. The charts show that the clusters are congregated in the celestial polar regions and along the Milky Way, and that nebulæ are most numerous in galactic polar regions, altho numerous in the celestial polar regions.

In the second table, 11,486 of the nebulæ are divided into ten grades of brightness. A maximum number of 3,322 are designated as "very faint" and two thirds of them are designated "faint" or fainter than "faint." The charts show that the nebulæ are most numerous in the region of the north galactic pole, particularly the 1,700 brighter and the 500 brightest nebulæ.

In the third table, 10,498 of the nebulæ are divided into ten grades of size, and two thirds of them are "small" or smaller than "small"; that is, less than 30″ in diameter. The maximum number, 3,587, are designated "small." The charts again show that most of the seven thousand small nebulæ, and of the two thousand nebulæ of mean size, and of the eight hundred large nebulæ are collected round about the north galactic pole, altho many are found in the celestial polar regions.

In the fourth table, 8,469 of the nebulæ are divided into ten grades of form, including "round," "irregular," "extended.". Again, two thirds are "round" and are quite evenly distributed among the four polar regions. Practically all of the 680 "irregular" nebulæ, however, are near the north galactic pole.

Further tables give the numerical relations between size and brightness for the stars in the separate squares of the sky, but not yet for the whole celestial sphere. Data upon condensation in the nebulæ are not yet analyzed. The relations between condensation and size, and form and brightness, and the directions of axes of symmetry in nebulæ are yet to be investigated.

The most obvious results of the investigation thus far are, first, that clusters and nebulæ incline to be antipodal classes of celestial objects, which is a well-known point; second, that the majority of nebulæ are "faint" and "small" and "round" and most numerous in the region of the north galactic pole.

G. F. PADDOCK.

THE RED STARS.

A little piece of correlation regarding the variability of red stars is given by Mr. BACKHOUSE of the West Hendon House Observatory in England, in the recent May number of the *Journal of the British Astronomical Association.* He was led to the matter by the question, Are all red stars variable? He has compiled a list of 118 stars which have been designated by observers as red or reddish, and has established ten grades of redness. These 118 stars are arranged in order of redness between the fourth and tenth grades. A summary gives the following results: All of the 12 very red stars between seventh and tenth grades are variables, while 10 of them are of spectral class N. Eighteen of the 19 quite red stars between sixth and seventh grades are variables, while 15 are of class N and one of class M. Fifteen of the 28 red stars between fifth and sixth grades are variables, while 12 are of class N and 10 of class M. Twenty of the 59 stars between fourth and fifth grades are variables, while 11 of them are of class N and 19 of class M and 16 of classes K and G. The percentage of variables in the four groups decreases as follows: 100, 95, 54, 34 per cent. All but one of the strongly red stars between sixth and tenth grades are variables and of class N. Nearly half, 48, of this list of red stars are of class N, and one quarter, 30, of class M. Eighty per cent of the class N stars and 50 per cent of class M are variables. While not all red stars are known to be variables, it appears that variability is related to spectral class and color.

G. F. PADDOCK.